patches, whereas a portion of the target image with a lower resolution as a upper hierarchy (e.g., level n−1) without the unit triangular patches of level n. Therefore, a difference in the size of the triangular patches between hierarchical levels may cause a generation of a gap between the adjacent triangular patches. As a result, the patch connection unit **13** remove the gap by connecting individual vertices existing between the adjacent triangular patches, and thus, it is possible to construct the continuous hierarchical mesh.

[0040] FIGS. **7**(*a*) to **7**(*g*) are diagrams illustrating connection methods for removing gaps generated between adjacent patches with different LOD levels according to an embodiment of the present invention. Those dotted regions in FIGS. **7**(*a*) to **7**(*g*) are one level lower than that of those regions without being dotted.

[0041] **FIG. 7**(*a*) illustrates an inter-patch connection method when one triangular patch of a lower hierarchical level is surrounded by three triangular patches of an lower hierarchical level (i.e., higher resolution). In this case, vertices of unit triangular patches within the three triangular patches of the lower hierarchical level, being disposed in the boundaries between the triangular patches of the upper hierarchical level and the triangular patch of the lower hierarchical level, are connected with each other, so that the triangular patch of the lower hierarchical level has the same unit triangular patch structure as the triangular patch of the lower hierarchical level. The vertex connection makes it possible to remove gaps between the adjacent triangular patches with different LOD levels.

[0042] FIGS. **7**(*b*) to (*d*) illustrate an inter-patch connection method when two triangular patches of an upper hierarchical level are arranged closely to one triangular patch of a lower hierarchical level. In this case, vertices of unit triangular patches included in the triangular patches of the upper hierarchical level, being disposed in the boundaries between the triangular patches of the upper hierarchical level and the triangular patch of the lower hierarchical level, are connected consecutively in the form of zigzags, so that gaps generated between the adjacent triangular patches with different LOD levels can be removed. For instance, as illustrated in **FIG. 7**(*d*), the inter-patch connection method in the case that two triangular patches of the upper hierarchical level are arranged adjacently to one triangular patch of the lower hierarchical level will be described in more detail.

[0043] Referring to **FIG. 8**(*a*), a in-between vertex of a first triangular patch of an lower hierarchical level(higher resolution) is connected with a in-between vertex allocated most closely to the first vertex among vertices of unit triangular patches of the second triangular patch of the lower hierarchical level allocated in opposite direction to the first triangular patch but facing with each other.

[0044] Referring to **FIG. 8**(*b*), the second vertex is connected with the third vertex allocated most closely to the second vertex among vertices of unit triangular patches of the first triangular patch allocated in opposite direction to the second triangular patch but facing with each other.

[0045] Referring to FIGS. **8** (C) and **8**(*d*), the third vertex is connected with a fourth vertex allocated at a side facing the third vertex among vertices of the unit triangular patches of the second triangular patch, so that gaps between the triangular patches with different LOD levels can be removed.

[0046] **FIG. 9** is a diagram illustrating a multi-level LOD terrain represented based on a screen error based LOD in accordance with an embodiment of the present invention.

[0047] The illustrated multi-level LOD terrain is obtained by sequential operations of: determining an LOD based on a screen error using the LOD determination unit **12**; and connecting adjacent patches with different LOD levels using the patch connection unit **13** according to the method described in FIGS. **7**(*a*) to **7**(*g*). As described above, the adjacent patches are connected without gaps between them. The final hierarchical mesh configured without gaps according to the present embodiment renders patches with a low LOD level with priority. That is, the rendering activity takes place in the order of the level n, the level n−1, . . . , and the level **1**. At this point, the hierarchical levels lower than the patches of the current hierarchical level should not be included in the final hierarchical mesh. For instance, if the current hierarchical level of the rendered patches is m, the patches of less than or equal to level m+1 should not be included in the final hierarchical mesh.

[0048] **FIG. 10** is a flowchart for describing sequential operations of configuring a multi-level LOD hierarchical mesh with different LOD levels in accordance with an embodiment of the present invention.

[0049] In operation **101**, using the patch configuration unit **11** of the apparatus **10**, triangular patches of a lower hierarchical level (e.g., an level m+1) are configured to include approximately k×k of triangular patches of an upper hierarchical level (e.g., an level m), where k is the number of horizontal and vertical grids of the highest LOD hierarchical level. Each hierarchical level configures the multi-level LOD hierarchical mesh with different LOD levels. The patch configuration unit **11** also regularly samples information on height of a target image such as a terrain model inputted from the input device **20** and allocates the sampled height information to each vertex of the triangular patches of the hierarchical mesh.

[0050] In operation **102**, an LOD level for each triangular patch of the hierarchical mesh is determined according to a view point of a virtual camera. As described in **FIG. 5**, the LOD level for each triangular patch of the hierarchical mesh can be determined by an error of the triangular patches displayed on a screen. Also, as described in **FIG. 6**, the LOD level of each hierarchical level can be determined according to a distance from the virtual camera to each vertex of the triangular patches.

[0051] In operation **103**, it is determined whether all triangular patches of the hierarchical mesh are represented. If the representation is completed, this operation stage is terminated, and if otherwise, next operation stages proceed.

[0052] In operation **104**, it is determined whether one triangular patch selected among the several triangular patches of the hierarchical mesh has the same LOD level as the adjacent triangular patch.

[0053] In operation **105**, if the selected triangular patch has the same LOD level, the triangular patch is represented with a currently set LOD level. If otherwise, an operation stage of 'A' proceeds.

[0054] The above operation stages from **103** to **105** are repeated for the rest triangular patches until the representation of the hierarchical mesh is completed.